

Application No. 10/611,743
Amendment dated February 2, 2006
Reply to Office Action dated October 4, 2005

REMARKS/ARGUMENTS

In the Office Action dated October 4, 2005, the Examiner noted that Applicants' submission for a Request for Continued Examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in the above-identified patent application after final rejection. The Examiner advised that since the application was eligible for continued examination and the fee, which was timely filed, was paid the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114 and Applicants' Amendment B has been entered.

In response to the Office Action of October 4, 2005, Applicants filed a Petition for an Extension of Time on even date herewith for a one (1) month extension of time for response from January 4, 2006 to February 4, 2006, and paid the required fee to cover the cost of the extension.

Applicants note with appreciation that the Examiner has found convincing Applicants' arguments that its previous amendment that specifies the ceramic membrane as being an oxide, carbide, or nitride overcomes Funke et al. as used in the previous Office Action. He states that this rejection has been amended [and] the rejection of the previous Office Action [has been] amended to incorporate the new limitations.

The Examiner states, however, that Applicants' argument that Funke et al. teaches to apply the monolayers to the surface of the membrane and as such fails to teach its claimed invention is not, in so far as this is considered to be pertinent to the rejections of the current Office action, found convincing. He states that since Funke et al. explicitly teaches to reduce the diameters of the pores of the membrane with the reactant, the surface that Funke et al. is concerned with must be the surface of the pore walls, concluding that this reads on the Applicants' claims.

Claims 2-24 remain in this application. Claim 10, a dependent claim, depending from Claim 4, has been amended to recite that the evacuating and refilling of the vessel with the reactive vapor is carried out for at least three or more times. As stated in the previous Response, Applicants have urged that Claims 2-24 contain patentable subject matter over the previously cited art of Funke et al., and Levy et al. and additionally now by this Amendment over newly cited prior art, Butler et al.

Applicants believe that the Examiner continues to misconstrue the clear teaching and disclosure of Funke et al. in his assertion that Funke et al. is concerned with depositing the monolayers on the surface of the pore walls of their zeolite or molecular sieve membranes. Applicants believe that this unsupported assertion by the Examiner is contrary to the clear teaching of the Funke et al. reference and submits herewith a Declaration by Dr. Roddie Judkins, who has worked as a Fossil Energy Program Manager and/or Director for over 19 years and in that management position is cognizant

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of the technical field of inorganic membranes, including zeolites and other similar molecular sieves, such as ALPO, SAPO, and MCM41 used and disclosed by Funke et al. to rebut the unsupported assertion by the Examiner.

As noted in Applicants' earlier Response nowhere does Funke et al. show the monolayer being deposited within the pores of the zeolite structure, despite the specification and drawings showing a modified zeolite structure having pores therein. Applicants cite for the Examiner's consideration particularly Col. 4, lines 33-37 where ..."a monomolecular layer 20 [is]deposited on the top surfaces 14 and side surfaces 16, 18 of the crystal to modify...." Also, more specifically in Fig. 1 where the monomolecular layer 20 is shown as being deposited on the referenced top surfaces (14) and side surfaces (16 and 18) of the modified zeolite membranes, not within the pores or on the pore walls of the zeolite crystals.

Thus, while the specification and drawings show a modified zeolite structure having pores therein, none show the monolayer being deposited within the pores of the zeolite structure. Nowhere could this be more clearly shown than in Fig. 6 which shows an enlarged isometric view of the zeolite crystals with the O-M bonds, which are formed by the reaction of the volatile molecules with the hydroxyl sites on the exposed surfaces 14, 16, and 18 of the zeolite crystals 12 and which are coordinated with ligands (identified as "L"). No materials are found to be deposited within the pores of the zeolite crystal 12. Applicants invite the Examiner to support his unsupported conclusion by identifying within the Specification and/or Drawings of Funke et al. where there is shown a deposit of the monomolecular layers within the pores, i.e., on the surface of the pore wall as asserted by the Examiner.

While Funke et al. does achieve a modification of the surface of the zeolite membrane by forming a monomolecular layer(s) on one or more surfaces of the zeolite crystals (See Fig. 1 where the monomolecular layer 14 covers the top surface as well as the side surfaces 16 and 18), the monomolecular layer(s), while porous to the passage of smaller molecules if kept to an extremely thin thickness (only a few 1-10 Angstroms), can also decrease the effective size of the pore openings 24. See Specification Col. 9, lines 27-29 where there is stated that "one monomolecular layer described in accordance with the invention may also have ... formed around and over pore openings 24 in the crystals 12."

It is submitted that a clear reading of the Funke et al. patent is that they were concerned about the gaps and defects that were formed in the manufacturing of the extremely small-pored zeolite and molecular sieve materials (e.g. about 5.4 Angstroms) and their invention was directed to providing a method for modifying the surfaces of these materials by depositing a monomolecular layer(s) over these gaps and defects. Nowhere does Funke et al. hint or suggest how to achieve a controlled process for reducing the ultimate size of a fundamentally different, and substantially larger (i.e. on the order of a

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35-40 Angstroms) ceramic membrane having material particles of metal oxide, carbide or nitride particles by depositing one monolayer at a time uniformly within the pores or interstices between the particles to form a ceramic inorganic membrane that is useful as molecular sieves.

The plain fact is that Funke et al. already had in its zeolite and similar molecular sieve materials a crystallographic structure that had pores of molecular dimensions (i.e., useful as molecular sieves) that needed no substantial trimming of the pore sizes (as is the case with Applicants' membranes) and as such the Funke et al. invention was in finding a way to modify the surface of its materials to block or clog the gaps or separations between adjacent crystalline structures that inherently are formed in the manufacture of the zeolite crystals or the defects in the zeolite crystals.

Claims 2-24 were rejected by the Examiner under 35 U.S.C. 103(a) as being unpatentable over Funke et al. (U.S. 6,051,517) in view of Butler et al. (U.S. 4,938,870).

The Examiner states that Funke et al. teaches the claimed process at Col. 4, lines 20-50, Col. 4, lines 60-68, Col. 7, lines 10-15, 25-30, and 60-65, Col. 8, lines 30-45, Col. 9, lines 1-3 and 35-50, Col. 10, lines 21-55 and Col. 11, lines 34-38. He further notes that the pore sizes disclosed in the examples after deposition of the layers are in the claimed ranges. He further states that Funke et al. teaches that the membrane may be zeolite or any other inorganic crystalline membrane that has surface hydroxyl groups. He notes that while Funke et al. is silent in teaching that the membrane is a metal oxide, Butler et al. teaches that porous metal oxide membranes are known in the art to have industrial application. From this, he concludes that it would have been obvious at the time the invention was made to a person having ordinary skill in the art to use metal oxide as the ceramic membrane material in Funke et al.. And by doing so, one would have a reasonable expectation of success, as Funke et al. explicitly teaches the art recognized suitability of using other ceramic membranes and Butler et al. teach the industrial applicability of metal oxide membranes.

This rejection is respectfully traversed. As noted in the previous Response, it was submitted that the PTO had not met its initial burden of establishing a *prima facie* case for the Examiner's rejection of Claims 11-15 and 18-21, as amended, under 35 U.S.C. 103(a) on Funke et al. or in view of Levy et al. and it was urged that the rejection of Claims 11-15 and 18-21 be withdrawn.

It is submitted that for the same arguments presented by Applicants in its earlier Response, as well as those presented in this Response and the submitted Declaration under 1-1.32, the PTO has not for the current §103(a) obviousness rejection of Claims 2-24 on Funke et al. in view of Butler et al. satisfied the three requirements set by the courts and hence has not met the initial burden of establishing a *prima facie* case.

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With respect to the newly cited Butler et al. patent, which the Examiner cites for the teaching that porous metal oxide membranes are known in the art to have industrial application, it is submitted that Butler et al. teaches a process for preparing a composite sheet of a porous inorganic membrane, such as alumina, and a microporous inorganic film, such as gamma-alumina, overlaying a surface of the membrane with the average pore size of the microporous film being from 0.5 to 30 nm or 5.0 to 300 Angstroms. The inorganic film may be formed by applying a colloidal sol, which does not penetrate into the pores of the membrane, of an inorganic material to the membrane and subsequently drying by heating to form the composite ultrafiltration membrane.

It is believed that the Examiner continues to misconstrue the teaching of Funke et al. insofar as his conclusion is that Funke et al. teaches the process claimed by Applicants in claims 2-24, as now amended. A careful review of the specific sections of the Specification cited by the Examiner in this Office Action reveal a disclosure and teaching of depositing the monomolecular layer(s) on the surfaces of the zeolite crystals, not on the pore walls as claimed by Applicants. This distinction which is claimed by Applicants is a critical limitation that is not taught or suggested in the Funke et al. patent or in combination with Butler et al.

Additionally, it is submitted that the Examiner statements that Funke et al. teaches that the membrane, in addition to the zeolites, may be “any other inorganic crystalline membrane that has surface hydroxyl groups” is not supported by the Funke et al. Specification. Their teaching is limited to a particular narrow class of molecular sieves, e.g., ALPO, SAPO, or MCM41, which are structurally similar to the zeolites in that they have a crystalline structure with a narrow pore size distribution on a molecular scale, i.e., of about 5.4 Angstroms and which suffer from the same manufacturing process problem, i.e., the inherent formation of gaps and defects in the crystals that make the membranes unsuitable for use as molecular sieves.

The Examiner is, however, correct that Funke et al. does not teach that the membrane is a metal oxide. Butler et al. while it may show industrial application does not provide any hint or suggestion that such membranes might be useful in solving the problems addressed by Funke et al. for its zeolites or similar molecular sieves structures. It also offers no teaching that a controlled process, as Applicants,’ for reducing the pore sizes of inorganic membrane materials, such as alumina or gamma-alumina, could be provided the art and in fact teaches away from such a process by its teaching that it is critical that the colloidal sol not penetrate into the pores of the membrane, of the inorganic material.

It is clear under the court cases that provide guidance in the PTO 103(a) obviousness rejection that the prior art reference or combination of references must teach or suggest all of the limitations of the claims and that the teaching or suggestion, as well as the expectation of success, must come from the prior art, not Applicants’ disclosure.

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Neither Funke et al. alone or in combination with Butler et al. teach or suggest Applicants' invention as now amended and it is submitted that neither can, in the absence of any teaching or suggestion, provide any expectation of success of a method as claimed by Applicants for preparing molecular sieve membranes comprised of metal oxides, metal nitrides, or metal carbides having mean pore diameters below about 20 Angstroms and as low as 5 Angstroms, which for the latter are comparable in pore size to the zeolites or similar molecular sieve membranes of Funke et al.

In support of these arguments, Applicants direct the Examiner's consideration to Dr. Judkins' Declaration under Rule 1-1.32. Dr. Judkins asserts that the statements in the rejection of Claims 2-24 of the Examiner, above, are in error and that it would not have been obvious from the teaching of Funke et al. in view of Butler et al. to use the metal oxide as the ceramic material in Funke et al. as the Examiner has concluded with any reasonable expectation of success. Further, he asserts that there simply is not a hint or suggestion found in Funke et al. that wholly different types of materials, such as the metal oxide membranes disclosed and claimed by Applicants, could be substituted for their zeolite or molecular sieve material with any reasonable expectation of success to prepare molecular sieve materials.

Accordingly, the rejection of Claims 2-24 under §103(a) based on Funke et al. alone or in combination with Butler et al. must be withdrawn.

The Examiner also rejected claims 14 and 15, noting that Funke et al. teaches the limitations of claim 4 but does not explicitly disclose coating only one side of the membrane, such as by placing the membrane on a holder. He notes that because the purpose of the membranes disclosed in the above references is to filter material, which involves passing a medium through the membrane to allow some material to pass through based on the adjusted pore size and such passing through is only usually performed from a single direction through the filter to avoid dislodging trapped material filtered out by the membrane, it would have been obvious to coat only the inflow side of the filter to adjust the pore size thereof because that is the side at which filtration is performed and coating only one side would have the clear advantages of saving process time and cost by coating only one side as opposed to both sides.

This rejection is respectfully traversed. It is to be noted that claim 14, as now amended, is a dependent claim, depending from now independent claim 4 and claim 15 is a dependent claim from claim 14. As such these claims incorporate all of the limitations found in now in independent claim 4.

It is submitted for the reasons given above that the Examiner is in error when he asserts that Funke et al. teaches the limitations of claim 4. He is correct when he states that

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Funke et al. does not explicitly disclose coating only one side of the membrane, such as by placing the membrane on a holder.

However, as noted above, the method disclosed in Funke et al. coats all surfaces of the zeolite crystals, i.e., on the top, side and bottom or other surface (gap or region between the juxtaposed faces of adjacent faces of the zeolite crystals). (See Figs.1 and 5 and text at Col. 6, lines 13-19 and lines 35-40). It is submitted that the method disclosed in the Funke et al. patent inherently coats all surfaces to modify the zeolite or other crystalline molecular sieves and therefore the requisite finding in the Funke et al. reference of a suggestion, incentive, or a reasonable expectation to coat only a single side of the membrane as found in the rejected claims is not found.

Absent a finding of the above-discussed three requisites, all of which must come from the Funke et al., it is submitted that the PTO has not established a *prima facie* case of obviousness and the rejection of claims 14 and 15 under 35 U.S.C. 103(a) on the Funke et al. reference must be withdrawn.

Lastly, the Examiner rejected claims 2-24 under 35 U.S.C. 103(a) as being unpatentable over either Funke et al. in view of Levy et al. The Examiner stated that Funke et al. did not explicitly disclose a gamma alumina or alumina membrane. However, because Levy et al. discloses that it is desirable to decrease the pore size of alumina membranes by depositing inorganic compounds thereon (Col. 7, line 23), it would have been obvious to have coated an alumina membrane by the process of Funke et al. with a reasonable expectation that doing so would successfully provide an alumina membrane having an adjusted pore size to tailor its filtration properties.

This rejection is respectfully traversed. As noted herein, the Funke et al. disclosure is limited to modifying zeolite or other crystalline membranes for separation of materials on a molecular scale. As such, Funke et al. require hydroxyl groups located on the surfaces of the zeolite or other crystalline molecular sieves to carry out its method for depositing monomolecular layers on these surfaces of the zeolite crystals. As noted by the Examiner, there is no disclosure in Funke et al. for the use of a gamma or an alumina membrane.

As noted above, the PTO has the burden under a §103 obvious rejection to establish a *prima facie* case. This initial burden is met by satisfying the requirements of: (1) the prior art relied upon, coupled with the knowledge generally available in the art at the time of the invention, must contain some suggestion or incentive that would have motivated the skilled artisan to modify or to combine references, (2) the proposed modification of the prior art must have had a reasonable expectation of success, determined from the vantage point of the skilled artisan at the time the invention was made, and (3) the prior art reference or combination of references must teach or suggest all the limitations of the

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claims. Further, the teachings or suggestions, as well as the expectation of success, must come from the prior art, not Applicants' disclosure.

The Examiner correctly noted that Funke et al. does not disclose a gamma or alumina membrane. A careful review of the Funke et al. patent finds that it is devoid of any suggestion or incentive that would have motivated one to modify or combine references, as suggested by the Examiner, to utilize their process, which is limited to modifying zeolite or crystalline molecular sieve membranes, to coat a different type of membrane, i.e., an alumina membrane. Clearly, the Funke et al. patent does not teach or suggest all of the limitations of rejected claims 2-24, as now amended. Given this lack of disclosure of any suggestion or motivation to modify their process, it is submitted that the Examiner's assertion that such a modification to the contrary would be met with a reasonable expectation of success in reducing the pore size of a gamma or alumina membrane by Applicants' claimed process is equally without merit.

Absent a finding of these three requisites, all of which must come from the Funke et al. in view of Levy et al. reference, it is submitted that the PTO has not established a *prima facie* case of obviousness and the rejection of claims 2-24 under 35 U.S.C. 103(a) and it is respectfully requested that the rejection on the Funke et al. alone or in combination with Levy et al. references must be withdrawn.

In view of the above remarks, the submitted Declaration under 1-1.32, and the amendments to claims 2-24, this application is now believed to be in condition for allowance which action by the Examiner is respectfully requested.

Respectfully submitted,



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